Journeys to Health Services in Great Britain: An Analysis of Changing Travel Patterns 1985-2006

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Abstract

This paper examines changing patterns in the utilisation and geographic access to health services in Great Britain using National Travel Survey data (1985-2006). The utilisation rate was derived using the proportion of journeys made to access health services. Geographic access was analysed by separating the concept into its accessibility and mobility dimensions. Regression analyses were conducted to investigate the differences between different socio-spatial groups in these indicators over the period 1985-2006. This study found that journey distances to health facilities were significantly shorter and also gradually reduced over the period in question for Londoners, females, those without a car or on low incomes, and older people. However, most of their rates of utilisation of health services were found to be significantly lower because their journey times were significantly longer and also gradually increased over the periods. These findings indicate that the rate of utilisation of health services largely depends on mobility level although previous research studies have traditionally overlooked the mobility dimension.

Keywords

Health services utilisation; geographic access; accessibility; mobility; distance decay

1. Introduction

This paper examines changes in the patterns of utilisation and geographic access to health services and also investigates the relationships between these in Great Britain (GB) over the period of 1985-2006. Although this type of analysis is not new, with work in other countries having been completed (for example in the USA (Buchmueller et al., 2006; Luo et al., 2004), China (Akin et al., 2005), India (Kumar, 2004), and Costa Rica (Rosero-Bixby, 2004)), a longitudinal analysis of data over a twenty year period has rarely been reported in the literature. In addition, no research has been conducted which examines the dynamics of health journeys in the context of GB with the exception of a number of studies that have examined changes in travel patterns associated with undertaking other types of activities such as commuting (Pooley and Turnbull, 2000; Titheridge and Hall, 2006), and shopping (De Kervenoael et al., 2006). Although the utilisation of health care facility depends on many factors (e.g. geographic, economic, cultural and political); geographic access has been identified as the most significant factor in underpinning the use of it (Kumar, 2004; Lovett et al., 2002; Rosero-Bixby, 2004).

Geographic access is a function of both access to opportunities (accessibility) and access to transport (mobility) (Battellino et al., 2005; Coyle et al., 2009; Hurni, 2006; Murawski and Church, 2009). This is largely due to the fact that despite being mobile, individuals may actually be unable to access health care due to the poor geographical distribution of services (inaccessibility) (Farrington-Douglas and Allen, 2005; Field, 2000; Stanley and Stanley, 2004). Whereas poor transport services can result in low or non-existent levels of mobility (immobility). Lovett et al. (2002) for example have shown that 13% of the population was not able to reach a GP in East Anglia due to the lack of daily bus services. This suggests that accessibility gains mean little when there is no viable means of transport for patients to access facilities (Murawski and Church, 2009).

Despite being a function of both accessibility and mobility, researchers have traditionally overlooked the mobility dimension in assessing the relationship between geographic access and utilisation of health care facilities (Niggebrugge et al., 2005); and consequently changes in mobility patterns over time (see, Akin et al., 2005; Buchmueller et al., 2006; Chan et al., 2006; Kumar, 2004; Luo et al., 2004; Rosero-Bixby, 2004). Instead, geographic distance from population centroids (e.g. post code, census tract) to the nearest service has been used as an indicator of accessibility, and has found that utilisation patterns decrease exponentially with distance. Although this distance decay concept is well grounded in the health geography literature (Arcury et al., 2005; Målqvist et al., 2010; Nemeta and Bailey, 2000; Tanser et al., 2006), this type of accessibility measure is highly spatially aggregated and does not take into account the differential abilities and travel behaviours exhibited by different groups living in the same area. Consequently, these studies do not provide the relative distance decay behaviour associated with the utilisation of health services. For instance, a car-owning individual can traverse a distance with relative ease whereas a non-car owning individual finds it difficult if no other mode of transport is available.

It is clear therefore that there are two important issues which are related to the measurement of geographic access to health services. Firstly, a disaggregated approach is required which is also related to the fact that certain groups (e.g. high-income) do not necessarily travel to the nearest facility if they have better options (e.g. a private clinic) to choose from (Buchmueller et al., 2006). Secondly, that even a disaggregated measure of the level of accessibility (e.g. individuals travel distance to healthcare) alone cannot capture evidence of the difficulties associated with travelling to a particular healthcare facility. As a result, therefore, there is a clear requirement to address the mobility dimension while measuring geographic access. Martin et al. (2002) have indicated that travel time or costs of travel can be used as a surrogate measure of mobility. This is due to the fact that these indicators reflect an individual’s ability to obtain a service and provides significant evidence of the interactions between locations, different demographic factors, and the availability of transport modes (Kumar, 2004; Morency et al., 2011).

Although revealed preference travel data such as travel distance and travel time have been widely used to identify patterns of accessibility and mobility in transport research, the application of these indicators to identify geographic access and consequently the rate of utilisation of health services is very rare (see, Buliung and Kanaroglou, 2006; Kamruzzaman et al., 2011; Morency et al., 2011; Schönfelder and Axhausen, 2003). Martin et al. (2002) have identified that a lack of sufficient empirical data covering wider geographic areas hinders the development of research opportunities using indicators such as journey time and journey distance. Due to a lack of empirical data, Chan et al. (2006) have derived measures of travel time and travel distance using Medicare billing data in five states (Alaska, Idaho, North Carolina, South Carolina, and Washington) in the US. This data contains ZIP codes both for the physician providing the care and patients, and as a result, allowed the calculation of realised travel distance and approximate travel time using the fastest route between the ZIP codes.

This discussion clearly suggests a research gap that exists in the measurement of geographic access to health services. This research intends to contribute to this gap by analysing disaggregated travel data (e.g. proportion of journeys made by different groups, journey distance, journey time) to assess the changing levels of utilisation, accessibility, and mobility to health services in GB between 1985 and 2006. Section 2 briefly reviews the key changes in both health and transport policies in GB. Section 3 discusses the development of methodology to identify changes in utilisation and geographic access to health services between different groups. The key findings of the applied methodology are discussed in Section 4. Based on these findings, Section 5 then goes on to discuss the implications of these findings in terms of the different measures used to assess geographic access to health services as well as the implication of these for policy. A number of studies have indicated that an examination of the rate of utilisation of health services is also a way in which the impacts of associated policy changes can be understood (Buchmueller et al., 2006; Chan et al., 2006; Field, 2000; Higgs, 1999; Luo et al., 2004; Panelli et al., 2006; Wellstood et al., 2006).

2. Changes in health and transport policies in GB

Although both transport and health policies have witnessed a number of key changes since the 1950s, the lack of transport as a barrier to access health services was not readily identified in GB until the beginning of this decade. Both policy areas have, however, been subject to reforms where cost containment and increasing competition rather than improving access to health services have been key policy objectives. A number of studies have dealt with the changes made between the 1950s and 2000 and is therefore not discussed here in detail (see, Bond, 1997; Glaister et al., 1998; Ham, 1996; Maynard and Bloor, 1995; Shaw et al., 2009; White and Farrington, 1998; Young, 1996). Briefly, the notable changes in transport policy can be summarised as the deregulation of local bus services under the Transport Act 1985 which came into effect from October 1986. The impacts of this deregulation have been documented as a decline in passenger trips, a growth in bus-kilometres travelled, an increase in average trip length, a rise in fares, and a restructuring of routes (White and Farrington, 1998). Rail privatisation, started in 1992 and completed in 1997, increased rail patronage and consequently reduced road traffic volumes (Knowles, 1998).

Key changes in health policy include the creation of a ‘quasi-market’ in 1990 by separating purchasing and provision functions of the NHS (National Health Services) and local authorities under the NHS and Community Care Act (Bond, 1997; Ham, 1996). This act enabled patients to choose between health practices on the basis of the care provided. Therefore, in an area with a lower level of practice density, some individuals had little choice but to move to another practice due to a lack of access to services (Whynes and Baines, 1998). The White Paper ‘The New NHS: modern, dependable’ abolished the purchasing power of GPs in 1997 whereas the 2000 NHS Plan provided opportunity for patients to choose four elective care providers for their treatment (started in 2005) (Brereton and Vasoodaven, 2010; Department of Health, 2000). Devolution gave the Northern Ireland Assembly, Scottish Parliament, and National Assembly for Wales great power over health and transport services in 1998. They now receive block grants that are not related to need but can be spent as they choose (Greer, 2009).

During early 2000, a number of transport studies, such as those conducted by the Department of the Environment, Transport and the Region (2000) in England, Church et al. (2000) in the context of London, and Hine and Mitchell (2001) in the context of Scotland, used a variety of travel data to establish a link between transport disadvantage and a lack of access to health facilities. These studies highlighted the need for a greater integration of transport and health policy. As a result, in 2003, the publication of an influential report from the Social Exclusion Unit entitled 'Transport and Social Exclusion: Making the Connections' addressed the problems associated with accessibility to a range of local services including health care (Hamer, 2004; Preston, 2009; Social Exclusion Unit, 2003). The report highlighted that those transport disadvantaged groups such as people on low incomes, those without access to a car, older people, and those living in rural areas have faced difficulty in making journeys from their homes to health services. This is largely due to the fact that most of the NHS services and facilities are largely inaccessible by public transport (Social Exclusion Unit, 2003). As a result, it is required now to conduct accessibility planning analysis to key services for the preparation of local transport plans (Cass et al., 2005; Currie and Stanley, 2008; Farrington and Farrington, 2005). In addition, positive outcomes were evident on a number of key policy objectives including the improvement of health by encouraging physical activity after the implementation of the smarter choice strategies (e.g. workplace travel plan, station area plan, school travel plan) in a number of pilot studies conducted between 2004 and 2009 (Department for Transport, 2004, 2010). As a result, the government has intended to role out these strategies nationally during the preparation of next round of local transport plans (Department for Transport, 2005, 2010).

Moreover, the Department of Health (2003b) emphasised the importance of improving the accessibility of health services in its cross-government programme ‘Tackling Health Inequalities: A Programme for Action’. Emphasis in this was placed on giving greater priority to accessibility when making decisions on the location of new hospitals and primary healthcare facilities, and also on the review of eligibility criteria for patient transport services[1] and the hospital travel cost scheme[2]. As yet the Department of Health has not made any improvement in these schemes and they have strongly been criticised (Citizens Advice, 2004; Farrington-Douglas and Allen, 2005). Patient access is also being prioritised in the modernisation of the NHS. The NHS Plan sets out the 10 year programme to transform the health service so that it is redesigned around the needs of patients (Department of Health, 2000). While recognising the need to maintain specialist treatment centres, the focus is on improving accessibility through the development of primary care services, particularly in disadvantaged areas, and the provision of local treatment services and the use of information technology. The development of high quality, sustainable solutions for local services, including provision of smaller hospitals at the heart of local communities, was set out in the Keeping the NHS Local: A New Direction of Travel (Department of Health, 2003a). Since the formation of the new Coalition Government, two white papers concerned with geographic access to health services were published in 2010. These included: Equity and excellence: Liberating the NHS (Department of Health, 2010a), and Healthy Lives, Healthy People: Our Strategy for Public Health in England (Department of Health, 2010b). The first white paper aims to increase expenditure to enhance accessibility to health services by providing better choices to any service provider including a consultant-led team, GP practice, treatment, and maternity services. The second white paper aims to reduce service need by promoting healthy lifestyles (e.g. increasing the number of health visitors for counselling, offering Olympic and Para-Olympic style sports competition at schools, launching physical

[1] An ambulance service is provided by hospitals to bring patients classified as having medical need for transport from home to hospital.

[2] Refunds the cost of travel to patients who are claiming certain benefits or tax credits.

activity initiatives for active ageing). Therefore, the focus of the latter white paper is similar to that the smarter choice strategies and both stress more on preventative measures to maintain health than curative health measures.

3. Methodology

National Travel Survey (NTS) data, available from the UK Data Archive, for the periods of 1972-73, 1975-76, 1985-86, 1988-95, 1995-01, and 2002-06 were downloaded and used in this research (Department for Transport, 2006; UKDA, 2010). The NTS collects self-reported travel diary data for seven days and is the main source of data on personal travel in GB. The NTS has long been used for decision making in a number of policy arenas such as transport, education, revenue and customs, environment, and food and rural affairs (Anderson et al., 2010). This data has also been extensively used by researchers since its inception (Landrock, 1981; Stead, 1999; Whelan, 2007). Variables from four different record types (datasets) within the databases of each period were found to be important for this research including the *primary sampling unit (PSU), households, individuals, and journeys*. These different datasets within each period were merged using their associated unique identifiers. However, variables that were consistently used in these surveys over this time period were only used in this research. These include: planning region, and type of area from the *PSU* dataset; household yearly income, car-ownership status, and home-ownership status from the *households* dataset; individuals' age, marital status, gender, travel difficulties, occupation, and driving licence from the *individuals* dataset; and journey purpose, mode of travel, overall travel time, overall journey time, and overall journey distance from the *journeys* dataset. Travel time is measured as the time spent travelling only excluding waiting and other methods of travel. Journey time is the difference between the time at which the respondent left their origin and time they arrived at their destination and as a result includes waiting time, and ineligible travel (short walks, off the public highway etc). However, a separate health trip category has not been reported within the journey purpose variable for the first two survey time periods, and as a result these were excluded from this analysis. For the remaining four periods, health related trips have been coded as ‘personal business medical’. These personal business medical trips include a visit to a doctor, dentist, optician, chiropodist, chemist and hospital (not just to visit). A total of 51725 individual trips were found to relate to the personal business medical category of trips reported in these four time periods (4638, 5320, 13388, and 28379 individual trips for the period of 1985-86, 1988-95, 1995-2001, and 2002-06 respectively) and were analysed in this research.

Variables extracted from the different datasets were reclassified and recoded in order to maintain consistency between different time periods if needed. For instance, a quintile classification of the household income variable was made to maintain the relativity of income thresholds over the different time periods. Variables from the *PSU, households*, and *individuals* datasets were used as explanatory variables. Whereas, variables extracted from the *journeys* dataset were used as dependent variables to identify patterns of utilisation i.e. the proportion/percentage of journeys made by different groups to access health facilities in a particular journey distance or journey time band or by using a certain mode of transport (Goddard and Smith, 2001); modal split, and geographic access to health services. A binary logistic regression analysis was conducted to identify the utilisation rate over the different time periods between different groups. This analysis shows the Odds Ratios (ORs) for different groups making a trip to utilise health services compared to their respective counterparts. Linear multiple regression analyses were conducted to then identify patterns of change in the accessibility and mobility levels of these groups.

A correlation analysis was conducted using the overall travel time (min) and overall journey time (min) associated with the 51725 individual trips. Figure 1a shows that these two dependent variables are highly inter-correlated. As a result, only the overall journey time variable is reported in this paper. This is due to the fact that journey time captures more complexity in the travel behaviour of different groups when making a health journey. A further correlation analysis was conducted using journey time and journey distance (tenths of miles) for these trips. Figure 1b shows that although these two measurements of distance are significantly correlated; only 45% of the observed variation in journey time can be explained by journey distance. As a result, the journey distance variable was also analysed in this research, in addition to journey time, to explore patterns of travel. This is because journey time varies according to the mode choice even though journey distance remains the same (Martin et al., 2002). In this study journey time and journey distance variables were not found to be normally distributed, a natural logarithmic transformation of these variables was made which produced a better fit , this is a widely used method in the travel behaviour research (Frank et al., 2000; Morency et al., 2011).

The part and partial correlations and the multicollinearity analysis results, using all the explanatory variables entered in the regression model show that a number of explanatory variables such as marital status, driving licence, occupation, home-ownership status, and travel difficulties had a lower level of tolerance value and a higher level of variance inflation factor (VIF). The collinearity diagnostics also confirmed that there were serious problems with multicollinearity. Several eigenvalues were found to be too close to 0, indicating that the predictors were highly inter-correlated and that small changes in the data values might lead to large changes in the estimates of the coefficients. As a result, these explanatory variables were excluded from the models and the models were tested again. The resulting analysis showed that none of the remaining explanatory variables had a multicollinearity problem. In addition, Table 1 shows that the representation of samples from Wales and Scotland within the planning region variable is much lower when compared to sample sizes from England. As a result, the planning region variable was also excluded from analysis in order to avoid a representativeness bias.

4. Results

4.1 Descriptive analysis

On average, 41% of journeys were made by car in all time periods, followed by taking lifts (29%), using a bus (12%), and walking (9%) (Table 2). A general data trend, found in Table

2, is the increase in the proportion of car trips to health facilities whereas the number of trips using the bus, taxi, train, taking lifts, and trips undertaken by other private and public transport decreased over these time periods. Although the proportion of walk trips decreased by 2.5% over the period 1985-86 to 1988-95, this trend, however, reversed in the following time periods. Bicycle use, however, gradually increased until the 1995-01 period, when it returned back to the same level (0.8%) as was found in the initial period (1985-86).

Figure 2 shows the distance and time decay patterns associated with the utilisation of health services in GB based on travel mode. A similar distance decay pattern can be found between the first two time periods (1985-86 and 1988-95) and between the last two time periods (1995-01 and 2002-06). A double peak in the distance decay curves associated with the utilisation of health services was evident in all periods when the car or bus was used as a transport mode. However, the location of these peaks decreased over the time period under investigation. A single peak located close to the respondents' home location is a dominant pattern in the utilisation of health services when people walked. The location of this peak has however decreased as walking has become a less important mode of transport. The utilisation rates also drop sharply when walking distance is increased to 2.5 miles. The time decay curves remain stable during the periods in which the utilisation rate decreased exponentially with travel time for the car, and in which the utilisation peak was found to be located around 23 minutes away when individuals walked or used the bus.

Table 3 and Figure 2 show that individuals walked to health services that were located less than 1.5 miles away. Due to the existence of two peaks in the data, one located at around 1-1.5 miles away and the other at around 4-5 miles away (Figure 2), Table 3 shows that the average bus journey distances to access health facilities were at a distance range of between 3.5 miles and 4.2 miles away. As with walking journeys, the first utilisation peak for the car was found to be located between 1 and 1.5 miles away from home whereas the second peak was located at around 8 miles away from home for the first two survey time periods which was reduced to at around 4 miles away from home during the last two survey periods (Figure 2). There are two implications associated with this finding. Firstly, that individuals frequently used the car to access health facilities even though it was located within waking distance. Secondly, that due to the existence of the second peak in utilisation, the average journey distance associated with car use increased to around 5 miles (Table 3). Despite bus journey distances being shorter than those associated with the car, the average journey times associated with using the bus were found to be double that of the car (at around 30 minutes compared to about 15 minutes) (Table 3 and Figure 2). Average journey distances for those taking lifts were found to be longer than car trip lengths in all time periods which suggests that individuals took lifts only when their required health services were located at more distant locations. Consequently, journey times associated with taking lifts were found to be higher when compared to car journey times in these periods. By comparison the train was only used for accessing destinations located more than 15 miles away. The average journey time associated with using the train was found to be more than an hour in all survey time periods.

Walking distance was found to have gradually decreased over the time periods of these surveys (from 1.43 miles in 1985-86 to 1.07 miles in 2002-06) as had walking time (Figure 2 and Table 3). A similar trend was found for the bicycle trips. However, bus journey distance increased by 13% from 3.72 miles in 1985-86 to 4.2 miles in 1988-95 and was then reduced by 16% to 3.51 miles in the following time period (1995-01). However, bus journey distance was found to have increased again to the levels found in the first survey period (1985-86). Car journey distance increased to 5.37 miles in 1988-95 from 4.99 miles in 1985-86, it, however, gradually decreased in the following survey periods to 4.86 miles in 2002-06. Despite these fluctuations in bus and car journey distance over these periods, Table 3 shows that the journey times associated with these two modes gradually increased over the periods. Gradual increases in both journey distances and journey times were evident over time when individuals tended to travel more by taking lifts.

4.2 Regression analysis

Table 4 shows the *t* coefficients from the linear regression analysis results using journey distances and journey times as dependent variables over the different time periods. These, therefore, represent the patterns of change in geographic access (accessibility and mobility) to health services between the different socio-spatial groups considered in this research whereas Table 5 shows the patterns of change in the utilisation of health services between these groups over the different survey time periods. The following subsections discuss these changing patterns for different user groups. An effort has also been made to examine the impacts of changing patterns of geographic access on the utilisation of health services by these groups.

4.2.1 Area type

Table 4 shows that journey distances were significantly higher in metropolitan built up areas, other urban areas, and rural areas in all four survey time periods when compared to journey distances in the London boroughs. This difference was also found to have grown over the time periods under investigation. Despite journey distances gradually increasing in these areas, journey times were, however, found to be significantly lower in all areas except the London boroughs. In addition, journey times were found to be decreased gradually in all these areas over the period 1985 - 2006. Despite these changing levels of accessibility and mobility, little difference was, however, found to exist between different types of areas in the utilisation of health services (Table 5).

Figure 3 shows the distance/time decay behaviour in the utilisation of health services for individuals in the London boroughs and rural areas. Two peaks are evident in the distance decay curve for individuals living in the London borough areas in 1985-86. About 30% visits were to a destination located within a range of 1.5 miles away from home whereas 25% visits were located around 4 miles away from home. A single peak is also observed, located around 8 miles away from home and is a dominant feature accounting for 30% of visits for rural people in this period. As a result, the average journey distance of rural people was found to be significantly higher. A similar pattern also existed in the period 1988-95 for both areas. No utilisation of health services was found to be evident within a distance of 1 mile from home in the first two survey time periods, although the later two periods witnessed some utilisation. The rate of utilisation was found to be much higher in the London boroughs (17-21%) compared to that of rural areas (12%). Another peak was also evident at a distance of 4 miles away from home for these areas in these periods. Consequently, the average journey distance remained higher in rural areas.

Despite utilisation rates being higher at longer distances from home for rural dwellers in all periods, 45% visits were found to take only 10 minutes for rural dwellers compared to 30% of visits in London boroughs in all time periods. With this exception the time decay curves remained almost identical in both areas and consequently the average journey times remained significantly lower in rural areas.

4.2.2 Car-ownership

Car-ownership was found to be a significant factor in the journey distance models. Table 4 shows that journey distances were significantly higher for car-owning individuals in all time periods when compared to their non-car owning counterparts. The data also shows that these differences increased over the time period under investigation. This is due to the fact that a higher utilisation rate was found to exist for non-car individuals at a distance closer to their home (Figure 4). However, despite car-owning individuals travelling a significantly longer distance to access health services (the second utilisation peak for this group occurs at a distance of about 4 miles), their journey times were found to be significantly lower in all time periods compared to their non-car counterparts due to a higher rate of utilisation within a very short travel time (45% car vs. 20% non-car) (Figure 4). These differences in journey time were also found to have become larger over time. The use of faster modes of travel, the car in this case, has, therefore enabled car-owning individuals to access health facilities more quickly despite larger travel distances. By comparison journey distances for non-car owners were significantly lower, and had also decreased over the time periods in question, yet their journey times were found to be higher over the same period of time. Despite these differences, car-owing individuals were found to be less likely to visit health services in all time periods although the differences in the utilisation rate between car owners and non-car owners were found to have reduced (Table 5).

4.2.3 Household income

No specific pattern was found to exist in terms of the effect of household income level on accessibility and mobility levels for the first two periods (1985-86 and 1988-95). In these periods, Table 4 shows that although higher income groups travelled a significantly longer distance, their travel times were found to be significantly lower in some instances. A more specific pattern was found to exist in the latest NTS survey period (2002-06). Table 4 shows during this period journey distances increased with income level, in other words higher income households travelled a significantly larger distance to access health facilities in this period. As in previous periods (1985-86 and 1988-95), these higher income individuals also spent a significantly shorter time travelling to health facilities when compared to those in the lowest income quintile group in this period (2002-06). Higher income groups, although travelling longer distances were found to have a higher rate of utilisation of health services due to their higher levels of mobility (Table 5). Figure 5 shows the distance/time decay behaviour of the highest and lowest income quintile group which was found to be similar to that of the car-owning and non-car owning groups. These findings suggest that a level of correlation therefore exists between car-ownership and household income in GB.

4.2.4 Gender

Females were found to travel significantly shorter distances to access health services although their travel time to access health services did not vary significantly when compared to their male counterparts except in the period of 2002-06 (Table 4). This indicates that females tended to rely on walking or public transport services to access health facilities which were located close to their home. An increase in the number of female car drivers over this period has resulted in a reduction in female journey times during the period 2002-06

(White, 2009). Despite these differences in travel behaviour, no gender difference was evident in this research in terms of the utilisation of health care facilities in any of the time periods covered by the NTS (Table 5).

4.2.5 Age

Table 4 and 5 show a significant difference by age in the levels of accessibility, mobility, and utilisation of health services. Individuals aged below 19 years travelled a significantly shorter distance in all time periods, and consequently their travel times were also found to be significantly lower compared to individuals aged between 19 and 59 years (Table 4). Individuals aged over 60 although travelling shorter distances compared to individuals aged between 19 and 59 years, were found to have journey times similar to other age groups. Table 5 shows that individuals aged under 19 years, compared to those aged 19-59, visited health facilities at a significantly higher rate in the first two time periods (1985-86 and 1988-95) although their rates of utilisation were found to be significantly lower in the later two periods (1995-01 and 2002-06). Despite having shorter travel distances, older and very elderly individuals were found to be less likely to visit health services in the first three time periods (Table 5). However, their utilisation rate was significantly higher in the period 2002-2006 compared to individuals aged between 19 and 59 years.

5. Discussion and conclusion

In order to identify the patterns of change in geographic access to health services and the relationship between geographic access and the utilisation of the health service in GB over the period of 1985-2006, individual level revealed preference data such as the proportion of trips made by different groups, journey distance, journey time, and choice of transport modes were analysed in this research. Differential levels of geographic access (both in terms of accessibility and mobility) to health services were identified in this research both within and between areas which suggest a differential policy impact upon different social and spatial groups. The findings of this research show that despite an increase in journey distance to health services across different areas (e.g. metropolitan built up areas, rural areas) over different time periods (1985-2006), journey time also decreased in these areas over the same time period. This finding signifies a shift of health services towards larger facilities due to economies of scale which has necessitated the rise of larger travel distances outside of London whilst at the same time an improvement in mobility levels in these areas primarily due to rise of car-ownership levels. The reductions in overall journey time could also be due to a restructuring of bus routes after deregulation and a reduced level of congestion outside of London (Schafer and Victor, 2000; White and Farrington, 1998). Schafer and Victor (2000) noted that Londoners spent 30% more time travelling than people in other parts of GB.

Despite the reduction of journey distance to health facilities in the London boroughs over the period 1985-2006, journey time, however, increased. This suggests an increased level of congestion over this period. An increase in car ownership levels, which is also a faster mode of transport (as was found in Section 4) has failed to improve mobility levels in London. Another possibility could be due to the choice effects associated with health policy in London where the number of health care services providers have traditionally presented a wider range of choices (Whynes and Baines, 1998). Individuals also prefer to attend the closest health service to their place of residence and as a result, there is an expectation that journey time would have reduced due to a reduction in journey distance, however, data indicates an increase in journey time. This suggests the existence of a mismatch between the location of health facilities and the provision of transport services over the time period in question. This has been highlighted in the literature (Social Exclusion Unit, 2003); and as a result, the accessibility gain has therefore brought no benefit to individuals in terms of mobility for those living in the London borough areas (Murawski and Church, 2009).

The findings of this research also suggest that the utilisation rate of health services not only depends on accessibility level but also on levels of mobility. Due to a lack of mobility related data, previous research studies have analysed only the levels of accessibility and have found that the utilisation rate is inversely related to distance (Higgs, 1999; Lovett et al., 2002; Sherwood and Lewis, 2000). However, the distance decay curves presented in this research have not only partially captured this relationship but have also revealed that a ‘double’ peak is a common phenomenon in the distance decay function. Whereas the time decay curves have proved to be exponentially related to the utilisation rate in this research. The inverse relationship associated with the distance decay curve was found to hold where the increased distance increases journey time to health facilities. A number of groups such as males, individuals living in metropolitan areas, other urban and rural areas were found to travel a significantly longer distance to access health services than other groups. However, despite this their rates of utilisation of health services were found to be the same as their counterparts because most of these individuals had an improved level of mobility (and as a consequence a lower journey time). An increased level of accessibility, however, failed to enhance utilisation of health services because this improvement in accessibility did not make a positive change in the mobility levels for certain groups (e.g. older individuals, very elderly individuals). In contrast, improved mobility has enhanced utilisation despite there being a poorer level of accessibility for higher income groups.

Evidence of the difficulties associated with travel and access health services for those transport disadvantaged groups was found to exist in this research. For instance, the rate of utilisation of health services of non-car owning individuals and individuals with a lower level of income was found to be significantly lower compared to other groups. Non-car owning and lower income groups tended to travel a significantly shorter distance, and their journey times to health facilities were found to be significantly higher. This finding, therefore, suggests the need to improve geographic access to services together with an enhanced mobility option for disadvantaged groups in order for them to have improved levels of access to health facilities. This research has also found that the volume of car trips for health services also increased steadily over the period 1985-2006 while all other modes accounted for a smaller number of trips. However, it is difficult to conclude from this research whether this increase in the volume of car trips was due to a lack of alternative transport or due to an increase in the level of car-ownership.

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7. Reference

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8. Tables

Table 1: Distribution of sample sizes (number of trips) by socio-spatial categories over the survey periods

Variables	Classification	1985-86		1988-95		1995-01		2002-06	
		N	%	N	%	N	%	N	%
Planning region	England	4021	86.70	4555	85.62	11555	86.31	24413	86.02
	Wales	219	4.72	339	6.37	728	5.44	1556	5.48
	Scotland	398	8.58	426	8.01	1105	8.25	2410	8.49
Type of area	London Boroughs	591	12.74	580	10.90	1458	10.89	2967	10.45
	Met built-up areas	716	15.44	673	12.65	1813	13.54	3980	14.02
	Other urban	2763	59.57	3397	63.85	8411	62.82	17685	62.32
	Rural	568	12.25	670	12.59	1706	12.74	3747	13.20
HH car ownership	Non-car	1297	27.96	1219	22.91	2897	21.64	5565	19.61
	Car-owning	3341	72.04	4101	77.09	10491	78.36	22814	80.39
HH income quintile	Lowest real income	557	12.01	965	18.14	-	-	6023	21.22
	Second level	869	18.74	1052	19.77	-	-	6738	23.74
	Third level	1021	22.01	1256	23.61	-	-	6220	21.92
	Fourth level	1046	22.55	1027	19.30	-	-	5112	18.01
	Highest real income	1145	24.69	1020	19.17	-	-	4286	15.10
Gender	Male	1944	41.91	2241	42.12	5684	42.46	12111	42.68
	Female	2694	58.09	3079	57.88	7704	57.54	16268	57.32
Age	Below 19 years	992	21.39	954	17.93	2098	15.67	3756	13.24
	19-59 years (young)	2282	49.20	2658	49.96	6359	47.50	12698	44.74
	60-69 years (older)	708	15.27	781	14.68	2159	16.13	5195	18.31
	70 years and above (very elderly)	656	14.14	927	17.42	2772	20.71	6730	23.71
Total trips	(51725)	4638		5320		13388		28379	

Table 2: Share of transport modes to access health facilities in different periods (%)

Mode	1985-86	1988-95	1995-01	2002-06	Overall
Walk	11.5	9.0	9.1	9.6	9.6
Bicycle	0.8	1.0	1.1	0.8	0.9
Bus	18.1	12.9	11.6	11.1	12.1
Car	29.9	39.1	41.4	43.2	41.1
Lift	32.0	29.6	29.3	28.8	29.3
Other private	3.3	2.8	2.1	2.3	2.4
Train	1.7	1.2	1.4	1.0	1.2
Taxi	-	4.3	3.9	3.0	3.1
Other public	2.7	0.1	0.2	0.0	0.3

Table 3: Mean journey distances and times by mode of transport to access health facilities in different time periods

Mode	Journey distance (mile)				Journey time (min)			
	1985-86	1988-95	1995-01	2002-06	1985-86	1988-95	1995-01	2002-06
Walk	1.43	1.42	1.12	1.07	23.30	22.84	23.23	23.20
Bicycle	1.62	1.42	1.51	1.49	15.41	12.56	14.71	14.60
Bus	3.72	4.20	3.51	3.73	27.98	29.45	30.59	31.45
Car	4.99	5.37	5.02	4.86	14.36	14.82	15.32	16.00
Lift	5.32	5.41	5.55	5.61	16.36	15.56	17.40	18.50
Train	16.05	17.95	19.09	20.23	67.27	61.63	62.07	65.97

Table 4: Linear regression analysis results showing the temporal variations in accessibility and mobility levels to health services

Variables	Classification	*t coefficient*							
		Journey distance (accessibility)				Journey time (mobility)			
		1985-86	1988-95	1995-01	2002-06	1985-86	1988-95	1995-01	2002-06
Type of area	London Boroughs (ref)								
	Met built-up areas	-0.25	3.18[b]	1.95	1.76	-4.27[b]	-2.31[b]	-6.52[b]	-14.15[b]
	Other urban	2.37[b]	1.48	4.63[b]	5.40[b]	-4.18[b]	-6.64[b]	-9.27[b]	-18.27[b]
	Rural	13.25[b]	10.09[b]	16.78[b]	26.82[b]	-0.42	-2.49[b]	-4.28[b]	-7.54[b]
Car ownership	Non-car (ref) vs. car	2.34[b]	5.89[b]	7.53[b]	7.33[b]	-16.53[b]	-12.49[b]	-25.13[b]	-31.25[b]
Income quintile[a]	Lowest real income (ref)								
	Second level	0.84	2.02[b]	-	-0.42	1.86	-0.58	-	-4.33[b]
	Third level	2.39[b]	-1.17	-	2.12[b]	1.41	-3.23[b]	-	-3.39[b]
	Fourth level	0.27	1.81	-	2.79[b]	-2.10[b]	-2.19[b]	-	-5.29[b]
	Highest real income	2.87[b]	3.16[b]	-	7.49[b]	-1.15	-1.79	-	-3.14[b]
Gender	Male (ref) vs. female	-3.06[b]	-1.44	-3.89[b]	-5.49[b]	-0.30	-0.36	-0.71	-2.75[b]
Age	19-59 years (ref)								
	Below 19 years	-5.49[b]	-6.19[b]	-8.81[b]	-4.65[b]	-2.28[b]	-2.49[b]	-3.33[b]	-2.30[b]
	Older (60-69 years)	-0.72	-2.50[b]	-2.25[b]	-1.34	1.79	1.04	2.48[b]	0.23
	Very elderly (70+ years)	-1.56	-2.18[b]	-5.70[b]	-4.87[b]	-2.01[b]	-0.49	-0.63	-1.54
F		30.98[b]	27.36[b]	77.09[b]	128.98[b]	41.81[b]	32.09[b]	103.46[b]	149.42[b]

[a] Income data has been reported as bands for the period of 1995-01, and as a result, it was not possible to derive income quintile to conduct regression analysis.
[b] Coefficients are significant at the 0.05 level.

Table 5: Binary logistic regression analysis results showing the temporal variations in the utilisation of health services

Variables	Classification	ORs			
		1985-86	1988-95	1995-01	2002-06
Type of area	London Boroughs (ref)				
	Met built-up areas	1.102	0.949	0.860[b]	1.105[b]
	Other urban	0.944	1.087	0.992	1.026
	Rural	0.986	1.055	0.914	1.045
Car ownership	Non-car (ref) vs. car	0.317[b]	0.578[b]	0.678[b]	0.886[b]
Income quintile[a]	Lowest real income (ref)				
	Second level	4.646[b]	3.051[b]	-	8.325[b]
	Third level	6.568[b]	3.988[b]	-	7.177[b]
	Fourth level	8.507[b]	3.812[b]	-	6.857[b]
	Highest real income	11.464[b]	4.354[b]	-	5.663[b]
Gender	Male (ref) vs. female	0.988	0.990	0.970	1.039
Age	Young (ref) (19-59 years)				
	Below 19 years	1.578[b]	1.168[b]	0.908[b]	0.818[b]
	Older (60-69 years)	0.926	0.806[b]	0.708[b]	1.326[b]
	Very elderly (70+ years)	0.604[b]	0.741[b]	0.710[b]	1.587[b]

[a] Income data has been reported as bands for the period of 1995-01, and as a result, it was not possible to derive income quintile to conduct regression analysis.
[b] Associated B coefficients are significant at the 0.05 level.

9. Figure captions

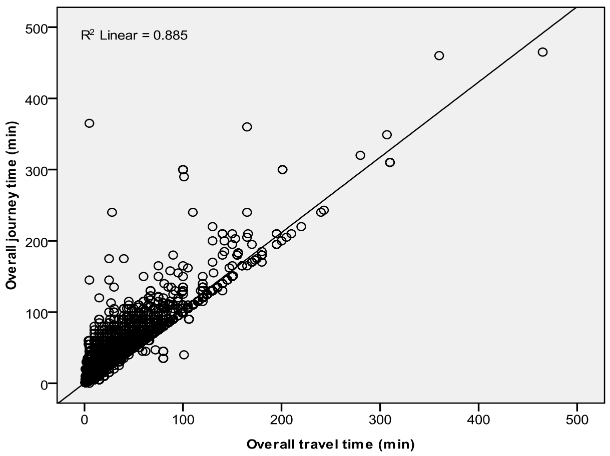
Fig. 1 Correlations between a) journey time and travel time, and b) journey distance and journey time

Fig. 2 Transport mode and distance/time decay behaviour in the utilisation of health services in GB over 1985-2006

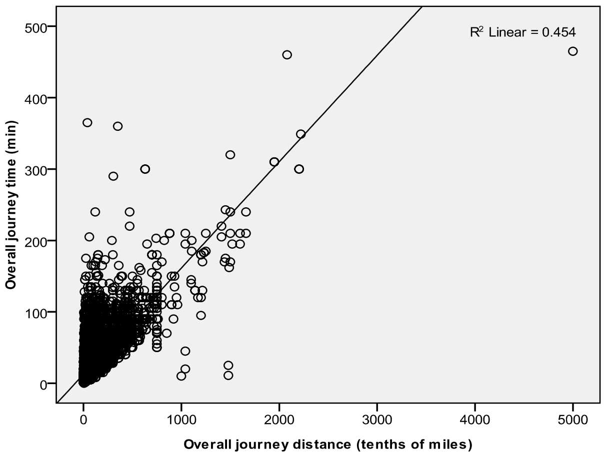
Fig. 3 Contextual differences and distance/time decay behaviour in the utilisation of health services in GB over 1985-2006

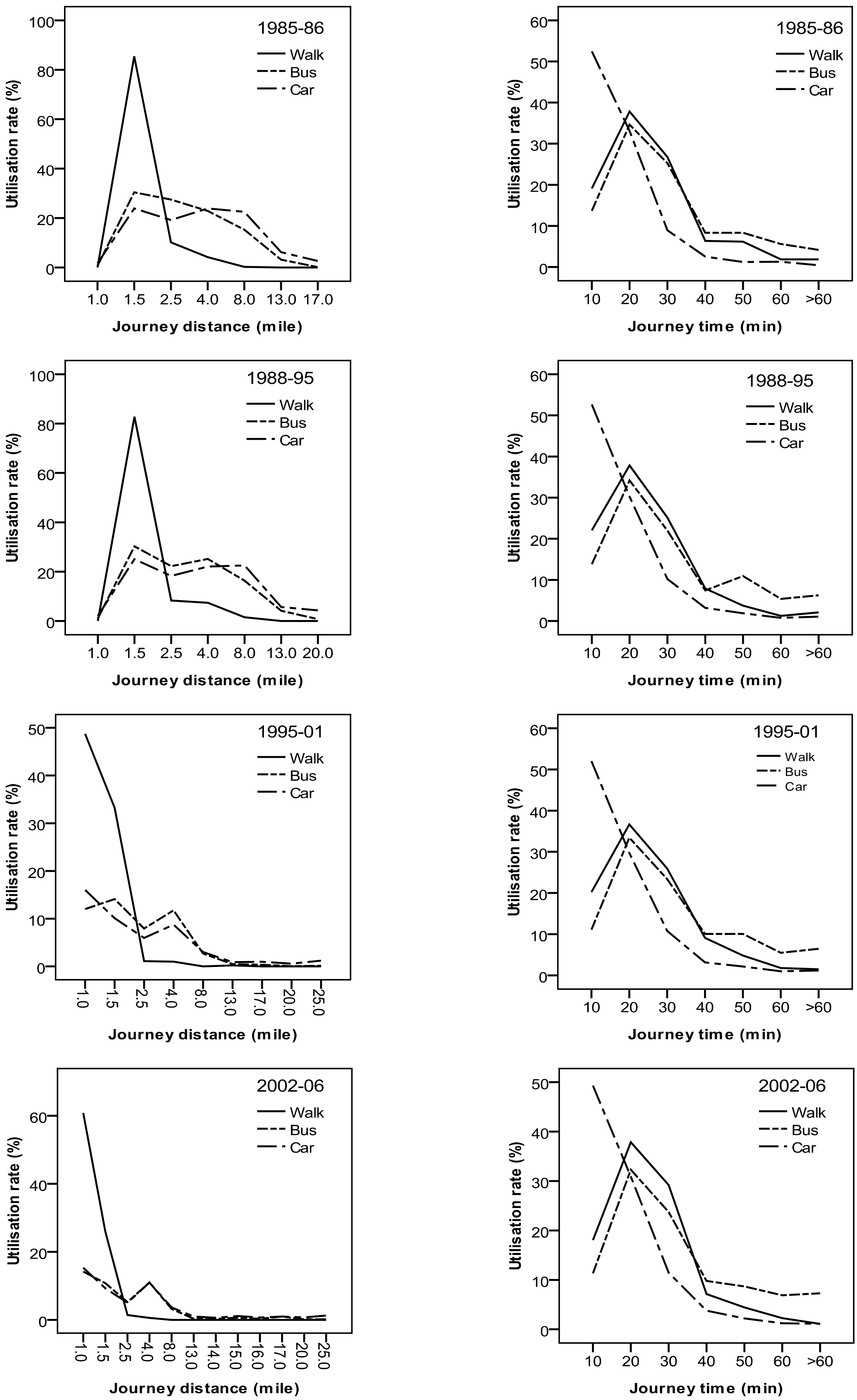
Fig. 4 Car-ownership status and distance/time decay behaviour in the utilisation of health services in GB over 1985-2006

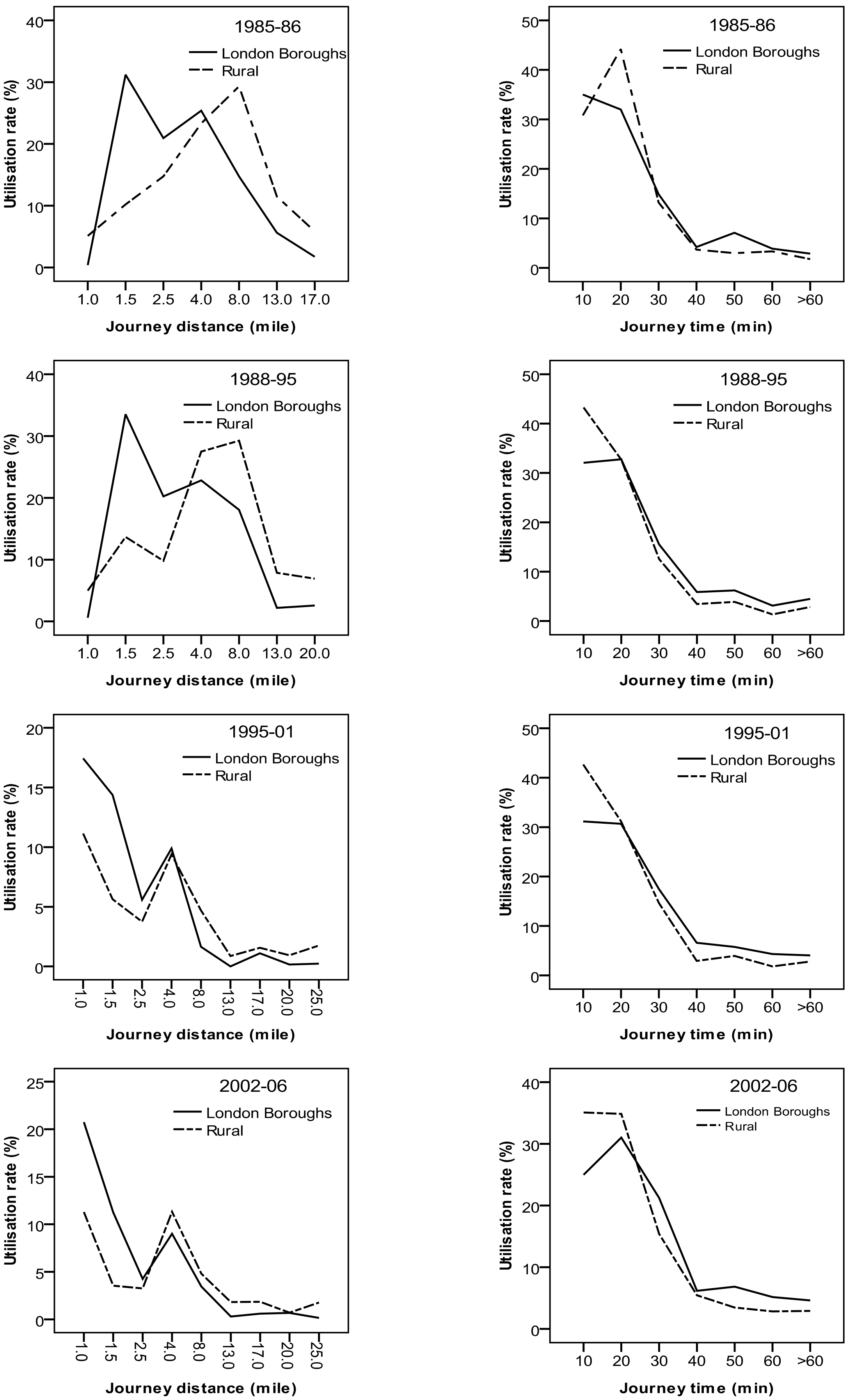
Fig. 5 Household income and distance/time decay behaviour in the utilisation of health services in GB over 1985-2006 a.

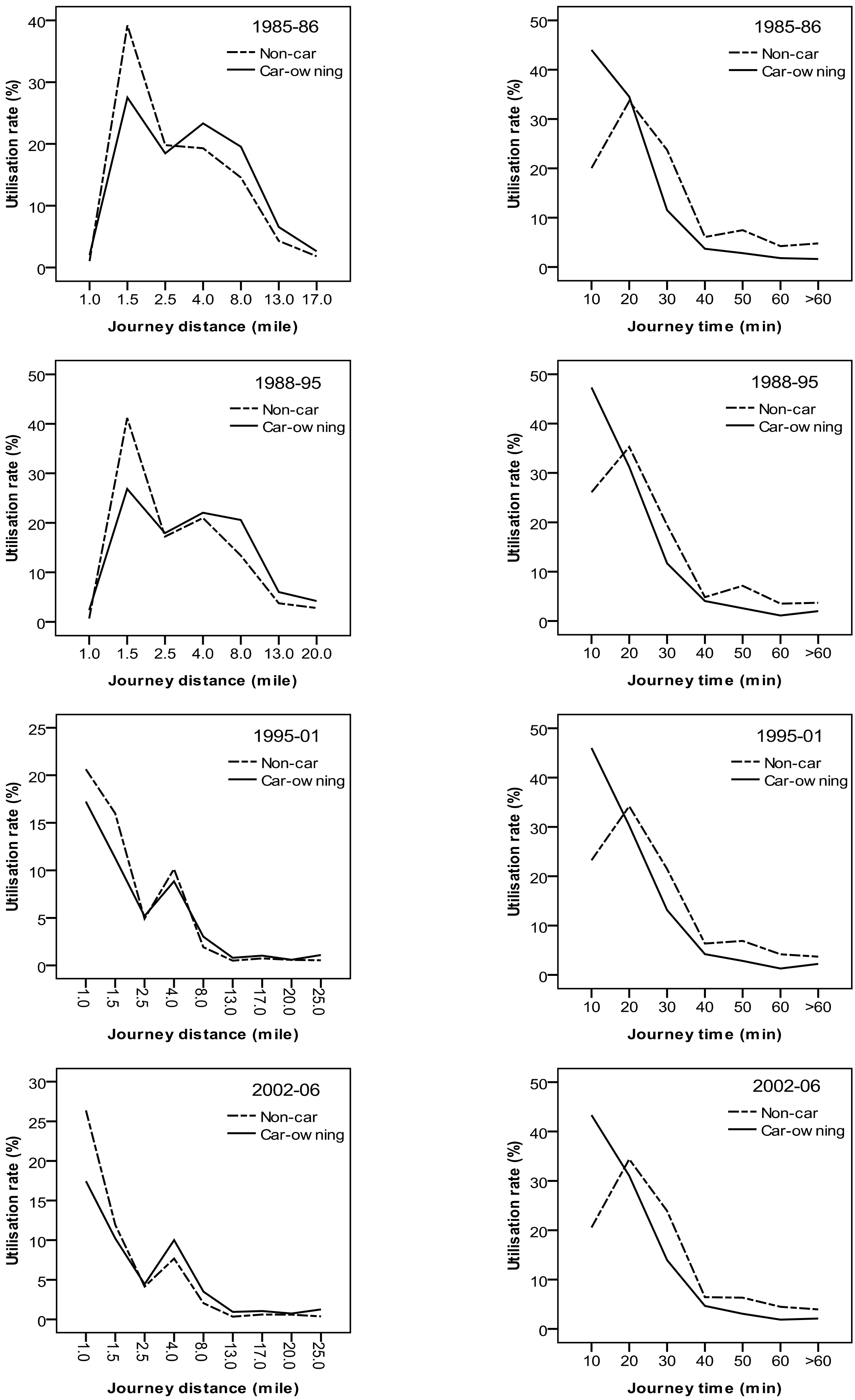

R² Linear = 0.885
Overall journey time (min)
Overall travel time (min)
0
100
200
300
400
500

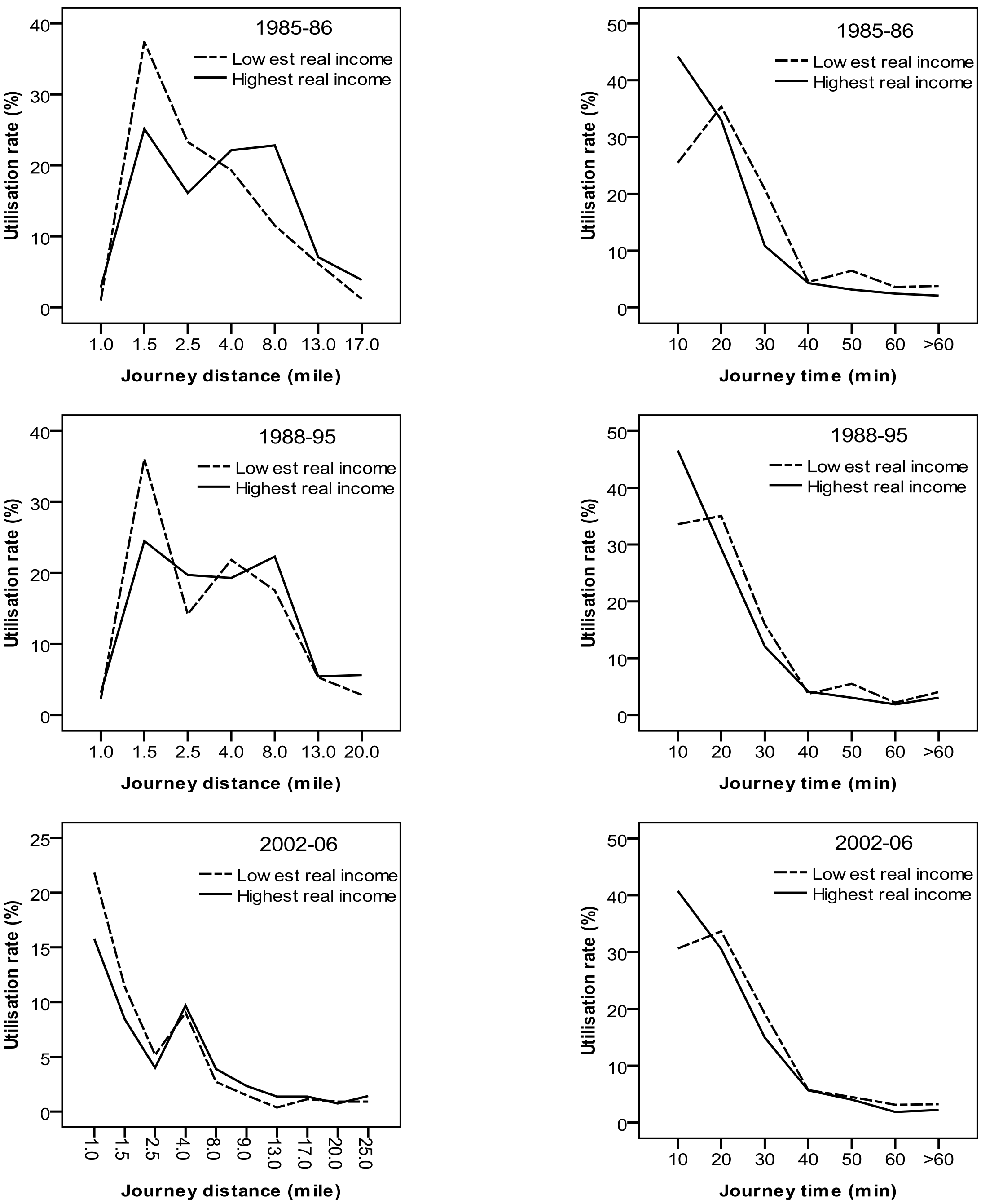
b.


R² Linear = 0.454
Overall journey time (min)
Overall journey distance (tenths of miles)
0
100
200
300
400
500
1000
2000
3000
4000
5000


1985-86
Walk
Bus
Car
Utilisation rate (%)
Journey distance (mile)
Journey time (min)
1988-95
1995-01
2002-06
1.0
1.5
2.5
4.0
8.0
13.0
14.0
15.0
16.0
17.0
20.0
25.0
10
20
30
40
50
60
>60


1985-86
London Boroughs
Rural
Utilisation rate (%)
Journey distance (mile)
1.0
1.5
2.5
4.0
8.0
13.0
17.0
1985-86
London Boroughs
Rural
Utilisation rate (%)
Journey time (min)
10
20
30
40
50
60
>60
1988-95
London Boroughs
Rural
Utilisation rate (%)
Journey distance (mile)
1.0
1.5
2.5
4.0
8.0
13.0
20.0
1988-95
London Boroughs
Rural
Utilisation rate (%)
Journey time (min)
1995-01
London Boroughs
Rural
Utilisation rate (%)
Journey distance (mile)
1.0
1.5
2.5
4.0
8.0
13.0
17.0
20.0
25.0
1995-01
London Boroughs
Rural
Utilisation rate (%)
Journey time (min)
2002-06
London Boroughs
Rural
Utilisation rate (%)
Journey distance (mile)
2002-06
London Boroughs
Rural
Utilisation rate (%)
Journey time (min)


1985-86
Non-car
Car-ow ning
Utilisation rate (%)
Journey distance (mile)
1.0 1.5 2.5 4.0 8.0 13.0 17.0
Journey time (min)
10 20 30 40 50 60 >60
1988-95
1.0 1.5 2.5 4.0 8.0 13.0 20.0
1995-01
1.0 1.5 2.5 4.0 8.0 13.0 17.0 20.0 25.0
2002-06


1985-86
Lowest real income
Highest real income
Utilisation rate (%)
Journey distance (mile)
Journey time (min)
1988-95
2002-06